Amendments to the Drawings

Attached is a replacement drawing sheet for amended Figure 1.

REMARKS

The abstract and specification have been amended in order to correct grammatical and idiomatic errors contained therein. No new matter has been added.

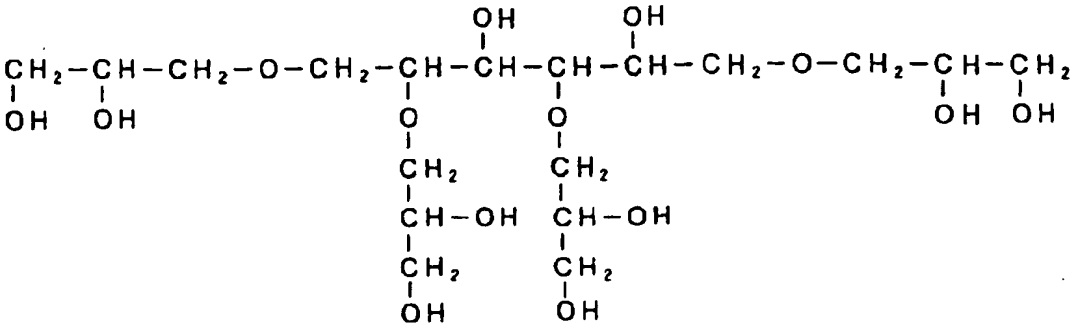
Enclosed herewith is a corrected drawing for Figure 1 in which it is indicated as being "prior art". Accordingly, the objection to Figure 1 has been overcome.

Claims 1-5 have been rejected under 35 USC 112, second paragraph. Claims 1-3 have been canceled and Claims 4 and 5 amended to address these rejections. It is respectfully submitted that the formal rejections of the claims no longer apply.

In order to expedite the prosecution of the present application, Claims 1-3 have been canceled and replaced by newly presented Claim 10 which more particularly points out and distinctly claims the subject matter which Applicants regard as the invention. No new matter has been added.

Claims 1-4 have been rejected under 35 USC 102(b) as anticipated by or, in the alternative, under 35 USC 103(a) as being obvious over Rockett. Claims 1-4 also have been rejected under 35 USC 102(b) as anticipated by or, in the alternative, under 35 USC 103(a) as obvious over Sawyer et al. Claims 1 and 3 have been rejected under 35 USC 102(b) as being anticipated by or, in the alternative, under 35 USC 103(a) as obvious over De Almeida et al. Claims 4 and 5 have been rejected under 35 USC 103(a) as being unpatentable over De Almeida et al in view of Watson. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to a copper electrolytic solution containing copper and an additive selected from the group consisting of at least one compound represented by chemical formulae (2) through (9), which is obtained by an addition reaction in which water is added to a compound having in a molecule at least one epoxy group:



(2)

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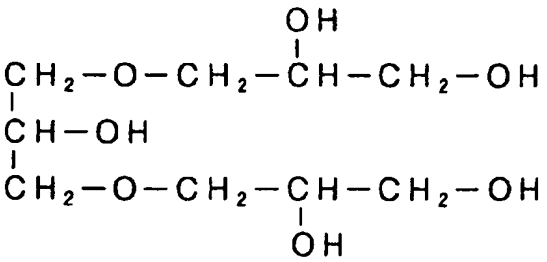

(3)

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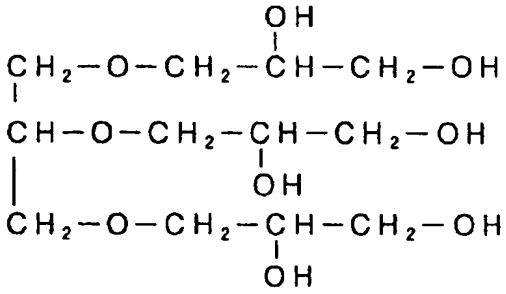

(4)

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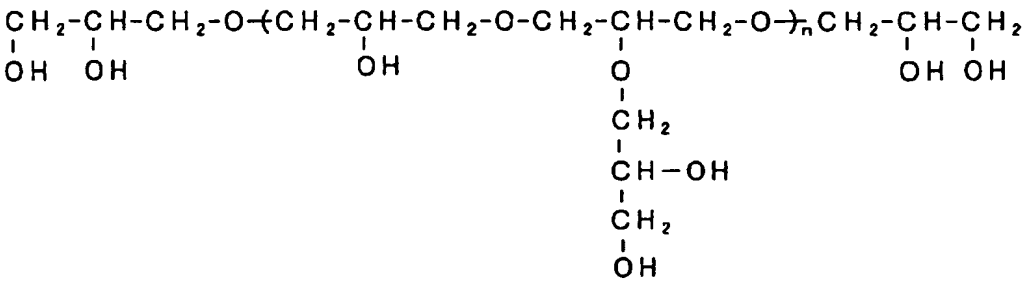
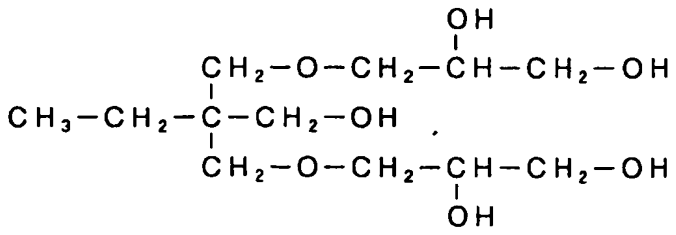


(5)

,

wherein n is an integer of 1 to 5;



(6)

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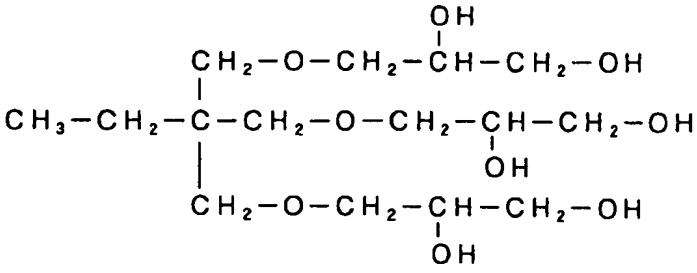

(7)

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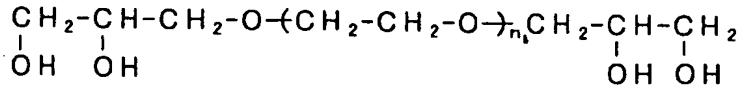
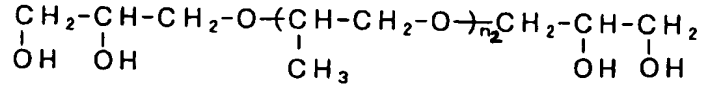


(8)

,

wherein n_1 is an integer of 1 to 22; and



(9)

wherein n_2 is an integer of 1 to 3.

As discussed in the present specification, the instant invention is directed to a copper electrolytic solution which can be used in the manufacture of electrolytic copper foils and two-layer flexible substrates and other printed wiring boards. In conventional electrolytic copper foil manufacture, a rotating metal cathode drum with a polished surface is provided along with an insoluble metal anode that surrounds the cathode drum and is disposed at a position that corresponds to the lower half of the cathode drum. A copper electrolytic solution flows between the cathode drum and the anode and a potential difference is provided between the anode

and cathode so that copper electrodeposits on the cathode drum. Electrodeposited copper is peeled away from the cathode drum when it reaches a desired thickness and is continuously produced. The copper foil in contact with the cathode drum has a mirror surface but the opposite side thereof has a rough surface with bumps and pits. This can present problems in that undercutting tends to occur during etching and fine patterning is made more difficult.

In order to overcome the problems presented with the roughened surface of the copper foil, additives have been added to the electrolytic copper plating solution in order to lower the profile of the rough surface area. Conventional additives such as glue or thiourea results in the profile of the rough surface being lowered but then create additional problems in that they negatively impact the mechanical properties of the product copper foil.

Two-layer flexible substrates have become increasingly more popular as substrates for flexible wiring boards. In these two-layer flexible substrates, a copper conductor layer is provided on an insulating film without an adhesive with an underlying metallic layer formed by dry plating on an insulating film and the electroplating copper film on top of that. However, the underlying metallic layer contains numerous pinholes which results in exposure of the insulating film and, in the case of a thin copper conductor layer, the areas exposed by the pinholes are not filled in and pinholes tend to occur in the surface of the copper conductor layer which leads to wiring defects. The present invention has been arrived at in order to overcome the problems associated with the prior art.

The copper electrolytic solution of the present invention provides a low profile electrolytic copper foil having a low surface roughness at the rough surface side and which has an excellent elongation and tensile strength that allows fine patterning. Additionally, the copper electrolytic solution of the present invention provides a uniform copper plating

without pin holes which can be used in a two-layer flexible substrate. It is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

The Rockett reference discloses a multifunctional viscocity index-improving lubricating oil comprising a hydrocarbon base oil and an ash-free, oil-soluble multifunctional additive having viscosity index-improving and detergency properties and comprising a copolymerization product obtained by copolymerizing polar allyl ether and/or vinyl ether compounds with two types of nonpolar unsaturated esters. One ester is a diester of an aliphatic alcohol and dicarboxylic acid and the other ester is an alkylene ester of a short chain fatty acid.

There is no disclosure in the Rockett reference of copper being present so this reference clearly does not disclose a copper electrolytic solution as required by the present invention. The additive in this reference cannot be used to prepare electrolytic copper foils, copper-clad laminates or copper printed wiring boards. The ether compound shown in column 2, line 20 of this reference is one reactive component and is polymerized with another reactive component, i.e., the ester reactive component in order to obtain the polymerization product. Neither the ether compound in column 2, line 20 or the copolymerized product with the esters of Rockett is the same as the compounds recited in the currently presented claims, which are obtained by an addition reaction between water and a compound having in a molecule at least one epoxy resin. Therefore, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over this reference.

The Sawyer et al reference is a study showing that the addition of non-ionic surface active compounds to solutions of a variety of anionic detergents enhance foam stability. Like the previously discussed reference, there is no disclosure in this reference of copper being present so there certainly is

no disclosure of a copper electrolytic solution. The detergent solution of this reference could not be used in the formation of an electrolytic copper foil and the glycerol ethers shown as foam stabilizers in this reference are not included in the additives required in the currently presented claims. Therefore, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over this reference.

The De Almeida et al reference discloses a non-cyanide electrolyte which can be used to deposit copper. This reference discloses that the copper electrolytic solutions shown there can contain glycerol. However, the glycerol disclosed in this reference does not correspond to any of the additive compounds of formulae (2) through (9) required in the present claims. As such, the secondary reference cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify the glycerol contained in the copper electrolytic plating solution of De Almeida et al in a manner that would yield the presently claimed invention. It is respectfully submitted that the secondary reference contains no such disclosure.

The Watson reference is directed to an acid copper electroplating bath containing brightening and leveling additives. This reference has been cited by the Examiner as disclosing organic sulfur compounds which could be added to the copper electrolytic plating solution of De Almeida et al in order to arrive at the subject matter of claims 4 and 5. However, since neither the De Almeida et al reference nor Watson disclose the additive compounds required in the currently presented claims, Watson in combination with the primary De Almeida et al reference does not even present a showing of prima facie obviousness under 35 USC 103(a).

Although the references cited by the Examiner do not even present a showing of prima facie obviousness under 35 USC 103(a), objective test data is of record in the present application which is more than sufficient to rebut any proper

rejection under 35 USC 103(a). Examples 1-13 in the present specification utilize copper electrolytic solutions according to the present invention containing the claimed additives. As shown by the results contained in the Declaration, these copper electrolytic solutions provide electrolytic copper foils having a dramatically lower profile and an enhanced tensile strength while also maintaining an elongation comparable to or higher than those achieved in the Comparative Examples in which the claimed additive was not present. Examples 14-19 show that copper electrolytic solutions according to the present invention have a much lower profile than the flexible substrates due to the addition of a compound having a specified skeleton structure required of the presently claimed additives as compared with flexible substrates obtained by the Comparative Examples not containing the additive compounds of the present invention. This further establishes the patentability of the presently claimed invention over the prior art cited by the Examiner.

Reconsideration of the present application and the passing of it to issue is respectfully solicited.

Respectfully submitted,

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Encl: Corrected Figure 1
Replacement Abstract
Clean Substitute Specification
Marked-Up Substitute Specification
Postal Card